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**COLLISION OF COMET SHOEMAKER-LEVY 9 WITH JUPITER:
IMPACT STUDY OF TWO FRAGMENTS FROM
TIMING OF PRECURSOR EVENTS**

Zdenek Sekanina

Jet Propulsion Laboratory, California Institute of Technology
Pasadena, California 91109, U.S.A.

The impacts of fragments K and R of cored Shoemaker-Levy 9 are investigated with the aims to interpret the timing of the observed precursors to the main thermal emission event and to correlate the results of ground-based infrared observations with a variety of observations made onboard the Galileo spacecraft. Analysis of the phenomena associated with the impact and explosion of fragment K shows that there is no discrepancy in the timing of the Earth- and Galileo-based observations and that the time of 53 ± 3 seconds between the emission peak of Precursor 1 and the onset of Precursor 2 can be interpreted as the interval between the impactor's disappearance behind the Jovian limb and the first appearance of the ejecta's plume over the limb following the explosion of the impactor's residual mass, as viewed by terrestrial observers. It is concluded that the impactor exploded at an altitude of 45 to 50 km above the pressure level of 1 bar and that the residual mass involved in the explosion, approximately 6 to 7 million tons and about 400 meters across, represented only a fraction of 1 percent of the fragment's preatmospheric mass. The explosion is calculated to have taken place under a dynamic pressure of several hundred bars and the dissipated energy is found to have been on the order of 10^{26} erg. The results for fragment R show it to be smaller and less massive than fragment K, exploding slightly higher in the Jovian stratosphere, 50-60 km above 1 bar. The preferred solutions suggest that the rate of ablation of these impactors was comparable with, or somewhat higher than, that of category IIIb fireballs in the Earth's atmosphere. These fireballs represent a population of objects consisting of "soft" cometary material, whose bulk density is typically 0.2 g/cm^3 . Preliminary evidence from other observations of the various fragments appears to be consistent with the present conclusions. All plume-expansion models based on penetrations below the clouds are incorrect and need major revisions. The successful prediction of explosion altitudes for the Shoemaker-Levy 9 fragments, based on the slightly modified fundamental equations of the classical theory of meteor physics and on ablation rates derived from data on relevant terrestrial fireballs, is a tribute to the meteor theory and demonstrates the versatility of its techniques in applications.